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Application of Sociocybernetic model in the field of Health Management

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Abstract— Health care, health care systems and consequently health care management is constantly evolving. Systems theory, the twentieth-century conceptual development, led to the widespread of Cybernetics (CS) and Sociocybernetics (SCS). In the framework above, SCS main ideas and tools can be implemented toward a new, evolving and efficient management model of the Health Sector that also narrows the disparities in health and in which medicine will be a team sport.

Index Terms— Computer System, Cybernetics, Healthcare, Health Management, Information and Communication Technology, ICT, Sociocybernetics

Introduction – Problem Definition

A system, open or closed according to its interaction with the environment / deterministic, semi deterministic or indeterministic according to its past and future trajectories, can be described as a set of detailed methods, procedures and routines created to carry out a specific activity, perform a duty, or solve a problem.

A system can also refer to an organized structure, possessing a certain purpose that consists of interrelated and interdependent elements, i.e. components, entities, factors, which constantly influence one another (directly or indirectly) to

maintain their activity and the system's existence, in order to achieve the system's goal.

However, it could be said that all systems are delineated by their spatial and temporal boundaries, surrounded and influenced by their environment, described by their structure and purpose and expressed in their functioning and characterized by entropy[1] (closed systems). Furthermore, all systems have inputs, outputs and feedback mechanisms (control mechanisms), and are characterised by homeostasis though they can display properties that are different from the whole, and that might not be possessed by any of the individual elements which, if removed or significantly changed, can lead to the cessation of the system's operation. Systems comprise interacting components or parts that may in themselves be systems and that result in emergent behaviours not found in the parts. As such, systems

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1 Entropy refers to this tendency for a closed system to move toward a random (less organized) state in which there is no further potential for energy transformation or work. This is the field of the second law of thermodynamics: an isolated or closed system proceeds spontaneously towards ever-increasing disorder. Open systems, by contrast, are not covered by the second law; biological and social systems receive energy, information and material that allow them to offset the process of entropy and stay alive; they become self-organizing.

thinkers generally hold to the adage that the whole is greater than the sum of parts (Straussfogel D. and von Schilling C., 2009). Hence, as system is a whole which is greater than its particular parts, it is a whole in which the particular parts have not an accidental relationship, and that quality makes the difference from an aggregate system. Though it is important to understand how systems work in order to affect sustainable change (Cordon C.P. 2013), it is not possible, in the context of this work, to analyse the full extent of General Systems Theory, system Thinking, Chaos Theory, Complex-Adaptive Systems, and Integral Theory etc., but only provide the reader with some basic terms.

Systems theory is a twentieth-century conceptual development in western science. It is the theory that our universe consists of different types of systems, i.e. open, closed, or isolated and different scales of systems, (Straussfogel D. and von Schilling C., 2009). The "General System Theory" was created by Ludwig von Bertalanffy in the late 1920s for biological and philosophical research. That approach[2] merged in North America in the 1950s with cybernetics, as well as a new system theoretical approach in engineering sciences in the 1950s. Systems theory has influenced the study of humans, machines and the natural environment within a broad spectrum of disciplines, including neurology, engineering, ecology, and human geography (Straussfogel D. and von Schilling C., 2009). It is known that while biologists initiated the systems approach, it quickly spread to gestalt psychologists interested in learning about perception and to physicists exploring quantum mechanics. Hierarchical theory, an area of the general systems theory, deals with the decomposition of a system into subsystems forming a hierarchical structure and is, therefore, a method for dealing with complexity. These subsystems (or infimals) are coordinated by a coordinator (or supremal) in such a way as to obtain original system objectives; hence, hierarchical theory is applicable to systems with a natural hierarchical structure or whose dimensionality is so high as to present computational difficulties (Smith N.J. and Sage A.P., 1973).

How we define or will define the hierarchy of structures or arrange them is a very crucial task. The notion above can be further held by the belief that the question "What is a social system?" cannot be answered by simply describing a specific system, because we do not know the significant relations that we must abstract when characterising an organization (Maturana, H. R., 1980). Furthermore, what determines the constitution of a social system, which is essentially a conservative system, are the recurrent interactions of the same autopoietic systems.

Recent approaches

The approach of Cybernetics and the more recent one, SocioCybernetics, can be utilized to achieve a modern, global health care system. At this point, it is important to stretch out that knowledge is a vital ingredient in conducting an appropriate /worthy/effective evaluation. It is essential for the person who conducts the evaluation to have knowledge in the field of evaluation; that is, he or she must be an expert in the evaluation and have skills in data collection and analysis, to begin with, as well as understanding the mechanism of achieving organizational change (Levin-Rozalis M., 2010).

The word Cybernetics (CS) originates from the Greek word kybernétes (Wiener, 1948), meaning

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2 Bertalanffy's General System Theory, or simply systems theory, became even more famous in humanities. According to Bertalanffy L.v., (1957) scientists can not reduce the biological, behavioural and social levels to the lowest level, that of the constructs and laws of physics. They can, however, find constructs and possibly laws within the individual levels. Hence, he proposed a unified principle of sciences in the organizational structure of the individual areas which join together to form a whole, and this principle aimed to find it. According to Seising R. (2010) Bertalanffy cited the exponential law of growth and certain differential equations as examples. His theory proceeded from the notion that the whole is greater than the sum of its parts, and integrated concepts like open systems, dynamic equilibrium and feedback. Systems theory is grounded historically in the study of and the quest for a general theory for all systems whereas more recently complexity theory has led to the study of patterns, networks, and evolution of complex systems.

"captain" or "to rule." It can be said that while a system deals with the structure, CS[3] deals with its ways of operation. Nowadays, scientists generally propose to deal with the process of creating new knowledge and understanding while exchanging different kinds of knowledge and actions within a complex system and its nested subsystems – as a cybernetic process (Levin-Rozalis M., 2010).

There are two orientations of CS, with one focusing on the general human question concerning knowledge. This orientation places the question "What is a social system?" within the conceptual framework of self-organisation (Negoita C.V., 1992), whereas the second orientation focuses more on the conception and design of technological developments based on feedback and mechanisms of circular causality, among other elements.

Wiener understood feedback processes to be of information manipulation and decision-making through binary questions, i.e. yes/no and defined the amount of information that a system transmits based on the number of decisions necessary to receive the information and gave statistical formulas. Information theory and CS would have far-reaching influence not only in science and technology but also in social sciences, humans and society as a whole. Wiener developed a meta-theory of feedback and governance operating across all systems, simple or complex. Scientists across the disciplines embraced these new "informational" and "cybernetic" methods. By re-conceiving traditional engineering theories of feedback and governance, Information theory and Cybernetics opened up new perspectives on "control" and "communication" in natural and social as well as living and inorganic systems (Seising R., 2010).

When dealing with CS in social systems, we deal with the meaning of knowledge, language, perception, communication, self-reference and self-reflection. However, CS also incorporate other notions, such as signals, noise and uncertainty as well as the fuzzy concept of information (Seising R., 2010), and while a system might have well-defined borders, cybernetic exchanges are open to the environment, adopting knowledge, values and norms that might create change by supplying them to different system or subsystem components (Heylighen & Joslyn, 2001).

As already implied, CS is closely linked to the term of feedback. Systems and subsystems have inputs and outputs among themselves. When the output of a system is fed back into the system as part of its own input in a process where some portion of the output signal of the system is passed (fed back) to the input, it is called feedback. Technically, feedback means that A affects B, and B affects A, and there can be numerous repetitions of this process; if Cybernetics is the science of organised complexity, then feedback is the science of cybernetics Levin-Rozalis M. (2010). The fact that the relationships between system elements can be as important as the nature and characteristics of these elements is what makes feedback processes so important (Emery, 1969). And feedback is what gives information to the system, but also according to Wiener (1968), the information is not so simple either, because when social systems are engaged, the meaning is subjective and interpretive. This is a process of autopoiesis or self-production: The activity of the system is determined by the system itself (Maturana & Varela, 1980). This idea easily leads to constructivist and relativism and subjective perceptions of knowledge generally meaning that two objects of the same system will not have the same perception of the system they are part of. However, the collection, elaboration and analysis of

3 CS was coined by Norbert Wiener, in his book "Cybernetics", to define the study of control and communication in the animal and the machine. They can be viewed in their most general sense as the study of the behavior of all possible machines, where machine refers to parts such as cells, brains, organisms and biological populations, where the notion of constraint is fundamental since the cyberneticist prefers to regard a property or mode of behavior as a constraint or restriction on a set of possibilities rather than as a unitary characteristic, (Ashby, W. R., 1956). As Weiner wrote in 1948, this idea occurred at about the same time to several writers, however one of the most important thing is that roots of ''information theory" can be found in Wiener's book, (Seising R., 2010).

data is not such easy work as it may be conceived of prima facie.[4]

SocioCybernetics (SCS) is an independent chapter of sociology based on the general systems theory and CS. SCS applies CS to the study of social and sociocultural system (Negoita C. V., 1992) and can be defined as the application of concepts, methods, and ideas of the so-called new CS or second-order cybernetics to the study of social and sociocultural systems. SocioCybernetics consists of the applications of first-order and especially second-order cybernetics to the social sciences and the further development of the latter. First-order cybernetics was developed in the 1940s, outside of the social sciences, whereas second-order cybernetics was developed to remedy the shortcomings of first-order cybernetics when applied to biology and the social sciences (F. Geyer, 2001). It is acknowledged that second-order CS is certainly enriched by the often unexpected results of social science studies in which the concepts of second-order CS are applied (Felix Geyer and Johannes van der Zouwen, 1992). According to Felix Geyer (1994), the second-order cybernetic way of thinking can contribute to the organisational attempts facing problems of very complex social situations. The main concepts of second-order CS, self-organisation /steering/reference, autocatalysis, autopoiesis, anascopic approach and the positive feedback loop can lead to the above. According to Felix Geyer and Johannes van der Zouwen (1992), SCS stresses and gives an epistemological foundation for science as an observer-observed system. Feedback and feedforward loops are not only constructed between the objects that are observed but also between them and the observer. The subjective and time-dependent character of knowledge is emphasised by this approach: Information, in the broadest sense of the word, is neither seen as inherently “out there,” waiting to be discovered by analytical minds, nor is it entirely viewed as a figment of the observer's own imagination or as an environment-independent automatic end-result of its own inner cognitive processes. Knowledge, to an extent, is constructed[5] and we take into consideration the approach according to which observer and observed are in interaction.

SCS and Health Management

According to Nicolopoulos Ph. (2000), modern society is a rationalised, a differentiated and mainly a quantitative and complex one; however, this society is not stable and includes a lot of contradictions and fluxes. Moreover, it could be said that there is a predominant knowledge gap in societies. The concept of a knowledge gap refers to the discrepancy in the amount of information acquired by different groups of people (Levin-Rozalis M., 2010). Also, it could be said that technology improvements and innovation impose pressure on human action. Once again, according to Nicolopoulos Ph. (2000), the only thing about which we can be sure is our will as organisations or individuals to contribute to a process of progress and qualitative stability as well as our choice to organise our activities in that direction.

Health is one of the highest human goods, and all citizens of all countries should be able to have access to high-quality health services. These services are specifically provided to citizens through the health care system of the country where they live or temporarily reside. The emerging future health care system is evolved by the effect of global trends that are shaping the new world map in its entirety.

4 Prima facie is a Latin expression meaning on its first encounter or at first sight. The term is used in modern legal English (including both Civil Law and Criminal Law) to signify that upon initial examination, sufficient corroborating evidence appears to exist to support a case. It denoted evidence that, unless rebutted, would be sufficient to prove a particular proposition or fact. Most legal proceedings require that he how has the burden of proof must present prima facie. The term is also used similarly in academic Philosophy.

5 Knowledge is constructed, and continually reconstructed, by the individual in open interaction with his environment (Negoita C.V., 1992).

The new demographics of health, disease and decease patterns have changed. Population growth, urbanization, swift of major city centers, environmental factors, the ageing of population (longer living means more deceases of old age and rising costs), the flee of refugees and the rise of lifestyle-related illnesses can all be considered results of entropy but are also the factors shaping the future health care system. Those changes in social, economic, political and demographic differences create the need for rationalization and development of health systems and the drug industry. It should be pointed out that, from an economic point of view, the health sector has been characterized by the laws of supply and demand, indicating that there is a shortage of resources. However, this seems to be changing; according to Diamantis and Kotler (2012), the exponential progress of fields, such as computing, medicine, 3D printing, robotics and artificial intelligence, will lead to the end of shortages of material goods and knowledge; this strengthens the idea that humanity is heading into an era of abundance.

Besides traditional ways of reducing cost, the reduction can occur as a side product of teamwork, in terms of efficient use of the heath care system's entities. Most of the money spent on health care for people with complex illnesses and chronic diseases, such as diabetes, heart failure and cancer. The traditional approach is that the doctor takes care of patients and their health, but chronic diseases require approximately an entire scientific team. In these cases, the key to cutting spending is proper coordination in order to avoid an excessive number of tests and therefore the analogous costs and discomfort of patients. The result will be health care of higher quality and a lower total cost. Apart from the changes in certain practices, we could greatly benefit from the use of global medical protocols, the establishments of day clinics, the use of a value-based system and personalized medicine, strong coordination and, of course, prevention.

Also, the case for investing in health promotion and noncommunicable disease prevention is stronger than it has ever been. Chronic noncommunicable diseases are the main cause of death and disability. Yet, the main risk factors associated with chronic diseases are largely preventable, and our research will attempt to provide some compelling evidence that addresses those risk factors with effective and efficient use of governments' money.

Actions to improve people's health by making their behaviours and consumption choices healthier are starting to receive more attention in European countries' public health policies. Countries are increasingly reluctant to accept the detrimental consequences of unhealthy habits, such as tobacco smoking, the harmful use of alcohol, unhealthy diets and sedentary lifestyles, among other risk factors. Our general research also attempts to document that governments can have a major impact on those behaviours by informing and educating people about healthier lifestyles, by raising the price of unhealthy choices and making them less affordable and by regulating business conduct in ways that would limit commercial influences on individual choices and ensure that healthier products get in the market; however, this is beyond the scope of this paper. Under the current economic situation and along with the current health demographic changes, it is high time to "upgrade" the funding model of health care systems and prevent illness.

Positive benefits on every level are expected from the spread of technology and innovation, and these are crucial trends that should be taken into account. According to Kurweill R. (2005), the exponential increase in technologies like computers, genetics, nanotechnology, robotics and artificial intelligence will lead to a technological singularity in the year 2045. Technological innovation and the development of novel sequencing methods promise to reduce the cost of large-scale sequencing projects (Maruyama et al, 2009), while the cost per Genome (the cost of sequencing a human-sized genome), according to the National Human Genome Research Institute, has fallen from 100 million USD (2001) to 5-8 thousand USD (2014). All of the above will lead to a higher quality of healthcare services at a lower, affordable to all, total cost. Positive benefits could also stem from the cooperation of states and organizations on a global level and by using technological achievements, i.e. the information provided by big data, ehealth, mhealth apps, can be the way to ameliorate the quality of services and to deal with new challenges that will arise in the health sector. It should also be noted that according to the research by Grinin L. E. et al. (2017), in the 2030s and 2040s, the sixth K-wave will merge with the final phase of the Cybernetic Revolution, and this period will be characterized by the breakthrough in medical technologies which will be capable of combining many other technologies into a single system of MANBRIC-technologies; namely, medico-additive nano-bio-Roboto-info-cognitive technologies.

In this context, the formulation of a new single health care system can be really challenging, and the usefulness of such a global system can be debated. Whereas principles of CS and SCS, e.g. the more conservative notion autopoiesis[6], can be applied and lead to a new, flexible, always evolving, health care system followed by a healthcare management plan with the same principles that fight entropy and make provision for global health and human rights. Perhaps in such a system, many infectious deceases that seemed to be largely conquered would not reappear.

Today, we are at a point where all entities involved in health care, potential stakeholders and beneficiaries should have a deeper understanding of the competitive forces that must work together to achieve positive results and of the technological possibilities (according to Diamatis P. (2015) and the 6 D's of Exponential, the growth progresses in technology can be Deceptive, Disruptive, Digitized, Dematerialized, Demonetized, Democratized) that can leverage and proceed through a continuous learning process to the improvement of health services. They can create flexible health systems within which public health will be addressed in a broader sense. For example, Smith P. C. et al. (2012) explored leadership and governance arrangements in seven developed health systems and presented a cybernetic model of leadership and governance comprising three fundamental functions: priority setting, performance monitoring and accountability arrangements.

In this context of cooperation, communities can and should participate actively in the design, delivery, monitoring and evaluation of health systems through empowerment, mobilization as well as wise and sensible use of resources and infrastructures. Doctors, researchers, health professionals, economists, politicians, health policy makers, patients, society and more should see the future and emerging trends not as a threat but as an opportunity for change.

According to WHO, health should not be defined as the absence of disease or infirmity, but as a state of complete physical, mental, phycological and social wellbeing. According to Fry, et al. (1995), health is a state both subjective and objective. Thus, health should include how people feel at every moment in their lives, and how well they behave and deal with individual situations arising from their daily activities. It is then obvious that, in order to formulate a proper health policy, we must take into consideration the specifics of all health care entities. However, as said, today even more due to the recent socio-economic crisis and due to future global trends, i.e. ageing, the health sector must reduce its costs while providing services of high quality to a wide range of people.

The schema above renders apparent the need for a holistic approach and a holistic governance model (characterized by strong leadership) for the health

6 Autopoiesis, meaning self-creation, was first introduced by Humberto Mturana and refers to a system capable of reproducing and maintaining itself. An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network, (Maturana, H. R., 1980). Maturana H. R. (1980) proposed the collection of autopoietic systems that would interact with each other constituting and integrating a system that operates as the medium in which they realize their autopoiesis is indistinguishable from a natural social system.

care system that would of course work under a strong legislative framework and a set of well-defined practices. At this point, it should be pointed out that holistic approaches go back to the Ancient Greek philosophers; for example, Aristotle described the importance of looking at systems as a whole (Cardon C, 2013). In this new Sociocybernetic model, knowledge will be shared amongst all system entities, the information will be in constant flow, and decisions will be taken autonomously, according to digital records and not only.

Discussion

Notions of SCS can be considered useful tools in order to face the contemporary problems of health care systems under the context of taking advantage that one of the main purposes of CS and SCS is to increase the efficiency of the human attempts to tackle the problems of the contemporary complicated society. In these terms, we could structure a modern Healthcare System: (1) to improve the distribution of health, (2) to meet the needs of people, patients and consumers, and (3) to protect families from poverty while also (4) lowering the cost of health services (because an unaffordable solution is not a solution) without lowering the quality of services while taking advantage of the available volume of knowledge and novel technologies. However, no such health care system can be constructed unless we all meet tomorrow's challenges today or if we do not take into consideration, the exponential growth progresses in Technology. After all, we must build a healthy future for all, together.

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